

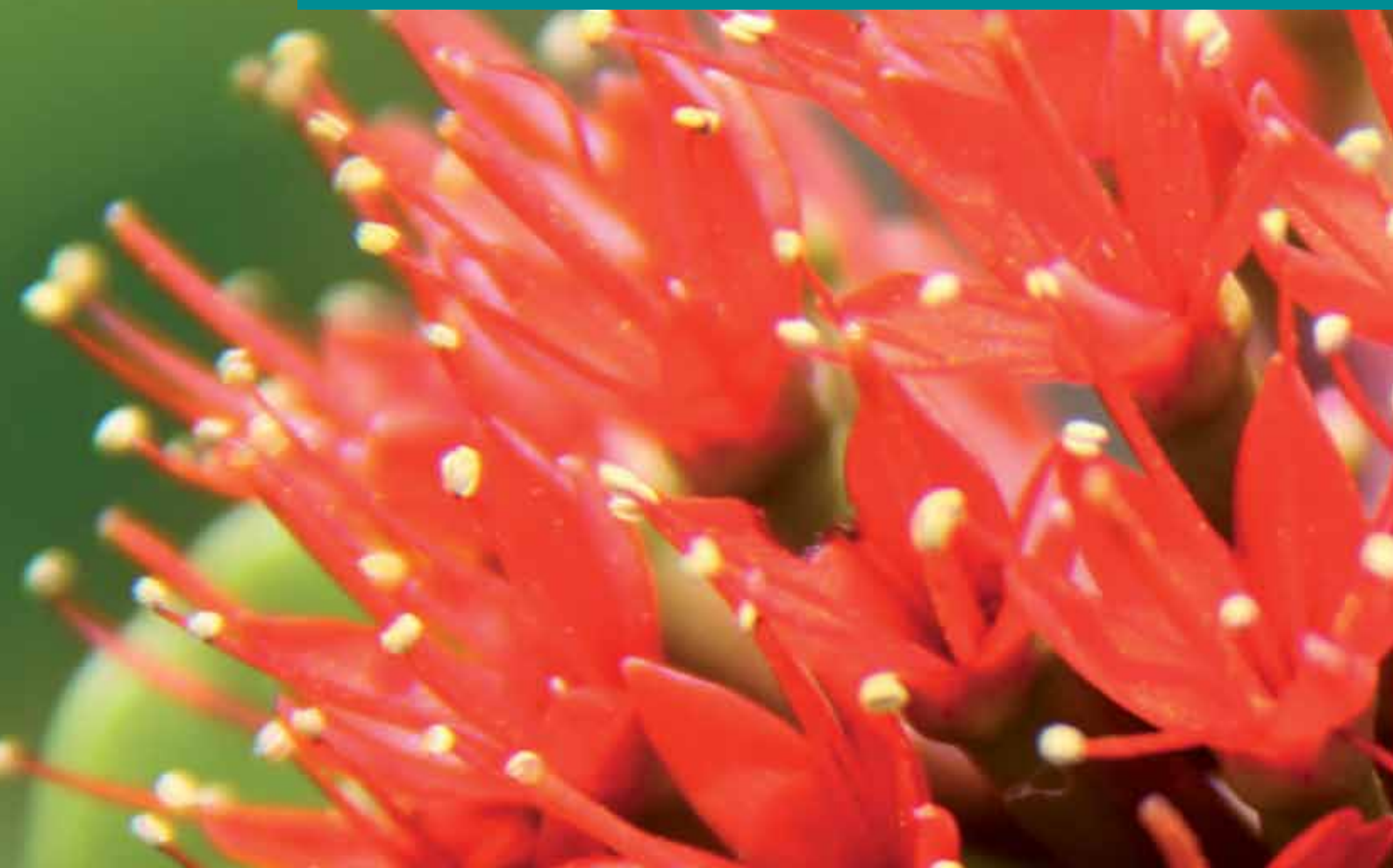
Phase One

# CONSERVATION AND DEVELOPMENT OF THE KIEN GIANG BIOSPHERE RESERVE PROJECT

June 2008 – June 2011

Climate Change, Conservation & Development  
Lessons learned and Practical Solutions

Pilot Project under the joint  
Australia – German Agreement of Cooperation



**giz**



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## About GIZ

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) was established on 1 January 2011. It brings together under one roof the long-standing expertise of the German Development Service (DED), the German Technical Cooperation (GTZ) and InWEnt – Capacity Building International, Germany. As a federally owned enterprise, it supports the German Government in achieving its objectives in the field of international cooperation for sustainable development. We are also engaged in international education work around the globe.

GIZ operates in many fields, including economic development and employment; governance and democracy; security, reconstruction, peace building and civil conflict transformation; food security, health and basic education; and environmental protection, resource conservation and climate change mitigation.

For many years, Viet Nam has been a priority partner country for German Development Cooperation. Projects and programmes cover the following three priority areas of cooperation, which are closely interlinked with the overarching goal of Poverty Reduction: 1) Sustainable Economic Development and Vocational Training; 2) Environmental Policy, Natural Resources and Urban Development; and 3) Health.

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## ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
ASS	Acid Sulphate Soils
aASS	Actual Acid Sulphate Soils
pASS	Potential Acid Sulphate Soils
AusAID	Australian Government Overseas Aid Program
CCCEP	Climate Change in Coastal Ecosystems Program
DARD	Department of Agriculture and Rural Development
DoCST	Department of Culture, Sport and Tourism
DoET	Department of Education and Training
DoF	Department of Finance
DoNRE	Department of Natural Resources and Environment
DoST	Department of Science and Technology
DPI	Department of Planning and Investment
GoV	Government of Viet Nam
KGBR	Kien Giang Biosphere reserve
MARD	Ministry for Agriculture and Rural Development
MPI	Ministry for Planning and Investment
PPC	Provincial Peoples Committee
ToT	Train of Trainers
WAR	Wildlife at Risk
WWF	World Wildlife Foundation

## 1

## EXECUTIVE SUMMARY

The Kien Giang Biosphere Reserve (KGBR) was established in 2006 and encompasses much of the coast line and adjacent marine areas of the Province as well as U Minh Thuong and Phu Quoc National Parks. The challenge for the Reserve is to balance sustainable economic development with conservation of the environment and particularly its unique biodiversity.

Based on the successful tri-partite cooperation between Australia, Germany and Viet Nam in Kien Giang and on the largeneed for further support in the Mekong Delta on issues of climate change, further funding support is being provided from the German Government and AusAID for a new program, the Climate Change in Coastal Ecosystems Program (CCCEP). This program will operate in five provinces and at national level. Components and subject areas form a program that is relevant throughout the Mekong Delta and combine to assist in the development and implementation of a functional strategic policy and legal framework and a new model of cooperative management between the five Lower Mekong Provinces supported by GIZ and AusAID.

Saline intrusion, conversion of the extensive areas of acid sulphate soils from potential to actual and extreme weather events resulting in overtopping of dykes are hazards already causing environmental damage that will be further exacerbated by predicted climate change.

The KGBR Project has addressed these issues in a number of ways with support from the other Provincial Departments, including

- Establishment of the Kien Giang Biosphere Reserve Board and Steering Committee.
- A public awareness program on the need for environmental conservation including radio and TV broadcasts and a Province Environment Day.
- Development of a new management plan for U Minh Thuong National Park.
- Training primary school teachers in climate change, environment conservation and waste management. Training was based on a resource book and simple materials and exercises for class work that were developed by the project.
- Assessment of the state of biodiversity in U Minh Thuong and Phu Quoc National Parks and training for rangers.
- Assessment of the condition of the Mangrove Protection Forest and coastline based on a new mapping technique using video images of the coast, satellite remote sensing images and ground surveys, developed in collaboration with the University of Queensland.
- Development of mangrove rehabilitation techniques with a very successful and novel nursery management system and planting regime coupled with melaleuca protection fences which entrap silt and reduce wave energy.
- Review of the coastal mangrove forest management system of 7:3 being trialled in Kien Giang whereby households may utilise up to 30% of the land they have been allocated for protection in livelihood enterprises, with strict caveats regarding how this area is used and located.
- New maps are now being used for Provincial planning of coastal zone management and the Sub Forest Inventory and Planning Institute trained in the use of the techniques.

- Design of coastal sea dykes that substantially decreases their vulnerability to erosion.
- Development of new uses for melaleuca timber such as for high quality furniture and for the coastal mangrove protection fences.
- Establishment of demonstrations of improved management of melaleuca forests with appropriate fertilising, planting density and thinning protocols.
- Development of sustainable livelihood options for households especially for women to undertake based on better utilisation of natural resources.
- Publication of a series of fact sheets, case studies and posters detailing project results in both Vietnamese and English and presentation of some of the results in International Symposia.



## 2

## AusAID/GIZ

## DELEGATED COOPERATION ARRANGEMENT

In February 2007 Australia and Germany signed a bilateral Memorandum of Understanding (MOU) aiming to foster efficient and effective development cooperation between the two countries in line with the principles of the Paris Declaration on Aid Effectiveness. In the context of the MOU, the German Agency for Technical Cooperation (GTZ) and AusAID began partnering on the 'Conservation and Development of Key Sites of the Man and the Biosphere Reserve' Project in Kien Giang Province in April 2008 under the principles of delegated cooperation.

Based on the success of the project in Kien Giang, Ministerial approval was given in February 2009 for AusAID to develop, in partnership with GTZ, a program to address the impacts of climate change in the Mekong Delta with an Australian contribution of up to A\$ 23 million over five years. This approval has led to the development of the Climate Change and Coastal Ecosystems Program (CCCEP).

In addition, in March 2010, AusAID and German Ministry of Development Cooperation (BMZ) signed the Joint Statement of Intent (JSol) outlining the collaborative framework of the two Parties on the development assistance in Vietnam. The JSol aims to strengthen the partnership between Germany and Australia in Vietnam focusing on the environment sector, with particular focus on climate change adaptation and mitigation in coastal zones and biodiversity.

3

## CLIMATE CHANGE AND COASTAL ECOSYSTEMS PROGRAM (CCCEP)

The climate change for coastal ecosystems program (CCCEP) is funded by the Australian and German Governments and implemented by GIZ and the Government of Viet Nam.

Executing Agencies are the Ministry of Agriculture and Rural Development (MARD) and the five Provincial People's Committees (PPC), Kien Giang, An Giang, Ca Mau, Soc Trang and Bac Lieu. Other GOV Partners include the Ministry of Natural Resources and Environment (MoNRE), Departments of Agriculture and Rural Development (DARD), Departments of Natural Resources and Environment (DoNRE), Department of Science and Technology (DoST).

The program duration is July 2011 to June 2016.

Australia will contribute US\$ 24.3 million to this program and Germany commits US\$ 14.1 million in technical cooperation. CCCEP will be implemented by GIZ, Deutsche Gesellschaft fuer Internationale Zusammenarbeit. In addition, Germany has committed US\$ 25.3 million of financial cooperation for dyke rehabilitation implemented by KfW.

People living in coastal areas are in danger from storm surges.

Mangroves provide resilience against climate change



The Intergovernmental Panel on Climate Change (IPCC) has named Viet Nam one of the countries' most vulnerable to the impacts of climate change. The Mekong Delta, a densely populated and low-laying region, is particularly prone to sea level rise and increasingly frequent and intense natural disasters such as typhoons, storms and floods.

The Mekong Delta is known as the "rice bowl" of Viet Nam due to its high agricultural productivity. The Delta was once renowned for its rich biodiversity, especially in the coastal wetlands, mangrove areas and *Melaleuca* forests, as well as the few remaining *Dipterocarp* forests.

These environments are under mounting threat from population pressure and the effects of climate change. Water and soil quality in the Delta is diminishing and ground water level continues to fall due to overuse. Water flow in the Mekong River is constrained by dams built upstream and insufficient levels of rain during the dry season.

The CCCEP will provide practical solutions for a range of environmental hazards threatening coastal ecosystems.

Provincial climate change adaptation plans will be developed as part of the initiative, and will include activities such as rehabilitating mangroves and improving dyke construction

and management. The plans will outline measures for better protecting coastal forests, such as ways for communities to learn about and adopt sustainable farming practices and promoting alternative income opportunities for communities dependent on coastal forests resulting in forest protection.

The overall objective of the CCCEP is to help Viet Nam manage and protect its coastal ecosystems which includes responding to the impact of climate change.

Success of the expanded program will be measured against the following key indicators:

- Climate change adaptation initiatives are incorporated into provincial planning processes and resourced under annual plans.
- The Government of Viet Nam allocates sufficient resources to support provincial climate change adaptation plans.
- The protection forest areas in the targeted provinces are maintained and restored.
- Innovative income opportunities increase the average income rates of the program target groups.
- Gender vulnerabilities are understood and addressed in provincial climate change adaptation plans.
- Increased awareness by Peoples Committees, staff of government institutions and local population about impacts of climate change.
- A coherent national policy framework for coastal ecosystem management is ratified and implemented by the Government of Viet Nam.

At the end of five years, it is anticipated that decision makers, staff of government institutions and local population will be more aware of the impacts of climate change and potential adaptation strategies. The National Government will have provided the necessary support to incorporate and implement plans for climate change adaptation into the provincial planning and funding processes. Information from successful pilot projects will be incorporated into coastal management plans. The biodiversity and extent of coastal forests will be protected and enhanced.



Catching crabs among the mangroves.



4

## KIEN GIANG BIOSPHERE RESERVE PROJECT

The project was funded by AusAID and implemented by GIZ and the People's Committee of Kien Giang Province (PPC). The other Partner is the Department of Science and Technology. The phase one project duration was June 2008 – July 2011 and phase two is from July 2011 to June 2016.

The project area is the Kien Giang Biosphere Reserve:

- **U Minh Thuong National Park** supports one of the last significant areas of peat swamp forest remaining in Viet Nam and is recognized as one of the three highest priority sites for wetland conservation in the Mekong delta. The Melaleuca forest in the core zone of the park plays an important role in maintaining soil and water quality in the buffer zone. Melaleuca forests filter the recharge of ground water and store fresh water during the dry season.
- **Phu Quoc National Park** stretches from mountain forests to coral reefs. The Park encompasses one of the last remaining dipterocarp forests in Viet Nam, Melaleuca and mangrove forest, important sea grass beds and coral reefs.
- **Kien Giang encompasses 200 km of coastline** with rich mangrove forests in places. This mangrove belt is essential for mitigation of the effect of sea level rise associated with climate change.

Kien Giang is located in the Mekong Delta and since 85% of the land area is less than one metre above sea level, most of the people live in low-lying areas which are at particular risk from rising sea levels and the increased frequency and intensity of natural disasters, such as typhoons, storms and floods. Economic pressure, poverty and the lack of knowledge result in non sustainable use of the coastal resources.

The objective is to develop sustainable natural resource management for Kien Giang Province particularly of the protected areas and coastal mangrove forests. The project is supporting the development of management and governance mechanisms for the Reserve and the National Parks. The executing agency is the Provincial Peoples Committee partnered by the Department of Science and Technology (DoST), but the Project collaborates with, and supports, the other Provincial Departments and especially the Department of Agriculture and Rural Development (DARD) and the Department of Natural Resources and Environment (DoNRE).

The project takes a participatory approach, and involves interaction between local farmers, the Women's Union, the Youth Union, and government officials. The project provides technical assistance to support poor people in the province, especially women. It successfully taps into existing livelihood and poverty alleviation programmes, and provides training and capacity building at province and district level for the conservation of biodiversity in selected communities. The project supports the Department of Agriculture and Rural Development in developing information materials that are adapted for the local population.

The target group includes the poor population who use the natural resources of the coastal forests, wetlands and key areas of the Biosphere Reserve, as well as land users in the province. Intermediaries are local authorities, Women's Union and Youth Union, and the staff and Management Board of the Biosphere Reserve and its key areas. The Project

also seeks to strengthen the National Park, Protection Forest and Coastal Management Boards through capacity building and a more comprehensive stakeholder involvement. The project has assembled a large collection of data bases and reports as well as conducting its own socio-economic biodiversity audits. These support the Provincial Department activities.

The Project also addresses the major issue of biodiversity and environment conservation in the context of rapid Provincial economic development and climate change. The project second phase will examine ways to buffer the effects of climate change on the Mekong River hydrology and its impact on the Province biodiversity and its primary production systems as well as ways to adapt to sea level rise. The planned expansion of tourism on Phu Quoc Island could have a deleterious effect on the very special biodiversity of the island unless managed carefully with proper planning processes. The Project has documented this biodiversity and will contribute to environmental impact analysis of the proposed developments.

Different training programmes are helping to improve the capacities and resources of the provincial and district administrations, so that they can build the resilience of the ecosystem. Departments are starting to consider spatial planning concepts, national park staff are using skills in fire and water management and biodiversity monitoring; primary school teachers are conducting training of teachers (ToT) for commune schools on how to use new resource materials on environmental management; province and district women’s union are providing ToT services to communes to disseminate information on livelihood improvement and awareness of climate change.



Community groups helping to plant mangroves

U Minh Thuong National Park core zone is recovering

National park rangers are trained to manage the biodiversity







## 5

# CLIMATE CHANGE – PROBLEMS AND SOLUTIONS

Climate change is predicted to affect the Mekong River flows through the affect on glacial melt, increased wet season rainfall in most of the catchments and decreased rainfall in the Lower Mekong Basin in the dry season by as much as 100-120 mm, a significant component of the present rainfall. The increase in intensity of rainfall will increase the risk of flooding. The rise in sea level, predicted to be 1 m by 2100 puts a large area of Kien Giang (85%) in danger of inundation from the sea. Already the sea level rise is affecting the integrity and extent of mangrove forests and dykes are being breached (see section 16). Saline intrusion is affecting agricultural production of the coastal zone already in Hon Dat District in Kien Giang. Where mangroves are absent dykes are not protected and already abnormal high tides and storms are causing overtopping of the dykes with sea water. The Project is supporting Province efforts to prevent this happening in future (see sections 17, 18, 19, 20, 21). The increase in night temperature with climate change will reduce yields of current rice varieties and it is unlikely that this will be much improved by plant breeding for adaptation.

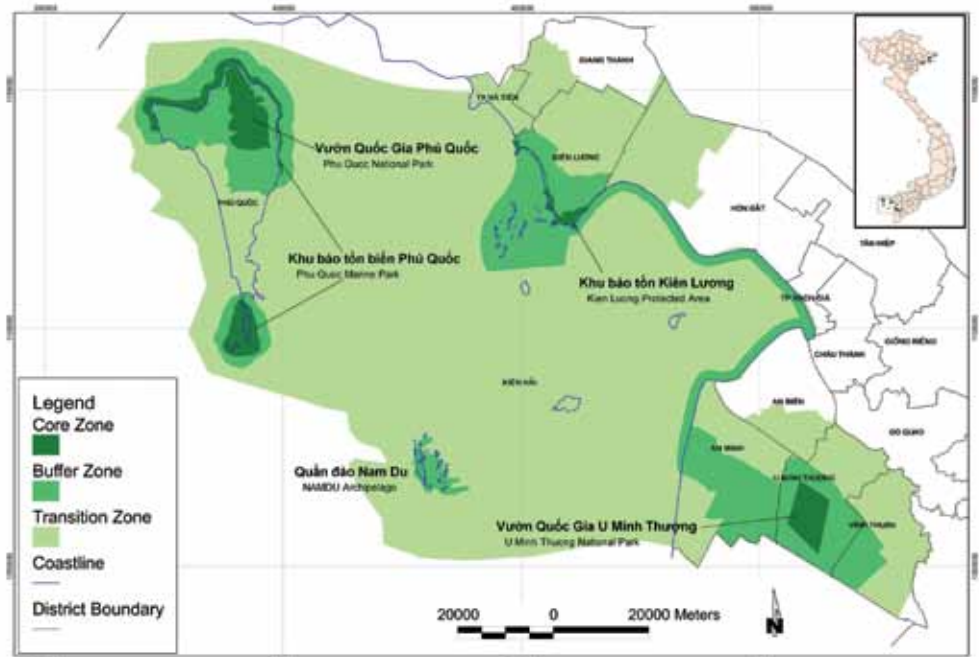
A major impending effect of climate change is on the conversion of potential acid sulphate soils to actual acid sulphate soils (ASS). Potential ASS occupy a large area of Kien Giang (see section 9). They are kept from producing acid by keeping the soil saturated with water. Once the soil dries out to the level of the potential ASS they will start producing a great deal of acid and this will affect rice and aquaculture production very badly. Climate change is already lowering the water table in the dry season. There are already anecdotal reports of production “crashes” and these may be due to acid production.

**The project is targeting the following issues in Kien Giang:**

Problem	Link to Climate Change	Solution
Inappropriate fire and water management damages the ecosystem	Appropriate management protects biodiversity against climate change	A new fire and water management regime established in U Minh Thuong. See section 12.
Natural Resource Management was poorly integrated	Strategic management helps prepare for climate change	A new biosphere reserve management board has been established. See sections 6, 17.
People are not aware of the need to protect the environment	Knowledge assists people to adapt to climate change	A comprehensive program has increased environmental awareness. See section 21.
Increasing salinity and acidity is reducing crop production	Alternative production systems provides resilience to climate change	New livelihood activities were introduced. Incomes have increased significantly. See section 20.
The value of melaleuca timber is low and farmers want to convert forests to rice.	Melaleuca forests provides resilience against climate change.	The project is developing melaleuca for use in fine, high value furniture and mangrove protection. See sections 8, 17.
Coastal erosion, salt intrusion, soil and water acidity require new technical solutions	Improved understanding of environmental systems supports adaptation to climate change	Skills have been developed through learning by doing activities. See sections 16, 18.
Phu Quoc National Park integrity is threatened by tourism and roads	Maintaining biodiversity provides resilience against climate change	Park staff are learning how to conserve biodiversity this will lead to better Park management. See section 13.
Most of Viet Nam's wetlands have been converted to rice production	Maintaining endangered environments provides resilience against climate change	The PPC is setting up a protected area in Phu My, the last remaining grassland in the Mekong Delta. See section 4.
Mangrove forests store large amounts of carbon but are being cut for short term gain	Storing carbon in forests mitigates against climate change	Payment for carbon will enable poor coastal communities to maintain protection of mangrove forests. See section 17.
30% of the coastline is being eroded	Video and satellite imaging show changes in coastline condition linked to climate change	A detailed spatial study provides assistance for provincial planning. See section 16.
Only two species of mangrove are commonly planted	Biodiversity of mangroves forests increase resilience against climate change	We can now germinate and grow ten mangrove species using low cost and low maintenance nurseries. See section 18.
Previously only 50% of planted mangroves survived	New melaleuca fence design protects planted mangrove seedlings, promotes recruitment and reduces erosion	Project designed melaleuca fences have reversed the erosion cycle and protect mangroves. See section 18.
Poor dyke construction methods are widespread	Dykes "buy time" as climate change causes sea level rise	The Department of Dykes and Irrigation is using new construction techniques introduced by the project. See section 19.

## 6 UNESCO BIOSPHERE RESERVES

Biosphere reserves, as designated by the UNESCO Man and the Biosphere Program, are “areas of terrestrial and coastal ecosystems which promote solutions that reconcile the conservation of biodiversity with its sustainable use”. The Kien Giang reserve was nominated by the Government and established in 2006 as one of 9 such reserves in Viet Nam. The reserves are meant to be “living laboratories” for testing and demonstrating integrated management and conservation of the natural resources of land, water and biodiversity. The reserves have a complementary and mutually reinforcing conservation function for landscapes, ecosystems, species and genetic diversity, an ecologically sustainable development function including both economic and human components, providing support for research, monitoring, education, and information exchange and dissemination.



The Kien Giang Reserve has a core zone of 36,935 ha, a buffer zone of 172,578 ha and a transition zone of 978,591 ha making a total of 1,118,105 ha.

The Biosphere Reserve is managed to conform to the UN Agenda 21 on the Convention on Biological Diversity and the Millenium Development Goals. The management system aims to engage the local community in preserving the ecological and cultural values of the Reserve. The core zones have legal protection as National Parks and Reserves. The zonation is designed to integrate the management of the National Parks and protected areas into the wider landscape. The coastal mangrove forests which are very diverse and play an important role in adaptation to climate change are not part of the core zone and hence subject to a range of management systems and economic activity. The biosphere reserve has special emphasis on preservation of many endangered species such as the Dugong, Green Sea Turtle and Sarus Crane.

June 21<sup>st</sup>, 2010, the Kien Giang Peoples Committee used decision number 1335/QD-UBND to set up a Biosphere Reserve Management Board and Steering Committee following



the model of the GIZ Project. This management system allows cross-sectoral integrated planning on adaptation for climate change, conservation, sustainable development for local communities, scientific research, education and training. The board is composed of representatives from the PPC, DoST, DPI, DoF, DoCST, DARD, DoNRE, District leaders and the GIZ Project.

A challenge for the Biosphere Reserve Management Board will be the National governments plan to increase tourism activity, already a major contributor to the Provincial income, largely through Phu Quoc Island. Phu Quoc has many natural attributes that would attract visitors but is at present relatively undeveloped particularly for International Tourists. It has a large National Park with much unique biodiversity (see section 13). This is under threat from incursions such as roads and coastal building developments. Of major concern is the construction of a major road traversing 15 km through the core zone, and the plan for a large water reservoir also in the core zone. In addition, 400 ha in the coastal area of the National Park have been approved for development.

For International tourists the natural beauty of the Island with its corals and dipterocarp forests are the drawcard and care must be taken to plan development for tourism so that they are not desecrated in the process of modernising. Appropriate planning processes with properly conducted Environmental Impact Analysis of any proposed development needs to be undertaken in order to preserve what is unique about Phu Quoc. That way income from tourism will increase and be sustainable. It is evident that, in view of these decisions taken by the National Government, that such changes need to be monitored by the biosphere reserve management board so that they take place with minimal destruction of environmental values and biodiversity.

The project is currently working with the management board to involve a range of different departments in decision making.

For example, to establish a nature reserve in Phu My to protect the habitat of the Saurus crane. The PPC is expected to declare an official decision on these areas in December 2011.



Saurus cranes visit  
Phu My wetlands



New road through the core zone  
of Phu Quoc National Park

7

## THE LOWER MEKONG DELTA

The Mekong river starts in the highlands of Yunnan Province in southern China and traverses through Laos, Thailand and Cambodia before reaching Viet Nam. There are 18 catchments contributing to and benefiting from the enormous expanse and flow of the river. The Mekong is one of the world's longest rivers (4,800 km) and home to 60 million people. The lower Mekong basin in Viet Nam occupies about 3.9 million ha and is one of the most densely populated regions in the world. Most of the Mekong delta in Viet Nam was originally melaleuca forest but with land allocation and Doi Moi and major support for canal development to drain flood waters it has been converted to a major rice growing and exporting region contributing to Viet Nam becoming the second largest exporter of rice after Thailand.

Major upstream events will impact on this lower Mekong delta productivity. The dams planned for hydro electricity and irrigation (23 in China alone) will affect the flow downstream. Although the Chinese dams will likely have a small effect on the volume of water they will affect the regularity of flows and enable irrigation scheduling in the dry season. Other dams are planned in Thailand and Laos. The lower Mekong basin dry season river flow is dependent on out-flow from the very large inland Ton Le Sap Lake in Cambodia and this is likely to decrease with the increase in irrigation for rice already occurring from the lake. Ton Le Sap fills in the wet season and flows out in the dry season into the lower Mekong basin. The river level in Viet Nam in the dry season has decreased. The dams are likely to have a major effect on fish migration and spawning and this is likely to affect the stock size. Fish are a major input to the diet of people living in the Mekong catchments.

The wet season flow in the lower Mekong basin is channelled into large canals of the basin (71 in Kien Giang mainly built since 1997) to take the waters that would otherwise flood the basin, to the sea. The canals have adversely affected the mangrove forests adjacent to the outlets because of the changed current dynamics. The canals supply the irrigation used for the 2 to 3 rice crops per year that are grown in the Delta Provinces. The opportunity to grow a second rice crop at the beginning of the wet season is affected by the dry season saline intrusion into the canals from the sea and the acid production from the canal banks needing to be flushed out before irrigation can start. During canal construction and dredging potential acid sulphate soil is deposited on the canal banks where during the dry season they produce a great deal of acid (see section 9) which the early rains flush into the canals often killing fish.

Fishermens houses  
along a drainage canal



Market on major drainage and transport canal in the Mekong Delta



Seasonal flooding in An Giang Province



The project is now closely linked with Mekong Climate Change Adaptation Initiative (CCA), facilitated by MRC, initially funded by AusAID, and now augmented by financial contributions from Denmark, Luxembourg and Sweden. Kien Giang is the pilot in Viet Nam for CCAI. This linkage will allow free flow of knowledge and information between the Mekong countries and Kien Giang and between Kien Giang and the other projects in the CCCEP.



## 8

# GEOGRAPHIC AND ENVIRONMENTAL CONTEXT

Kien Giang is a coastal province in the west part of the Mekong Delta. It is situated from 9 0 23'50" to 100 32'30" north and from 104 0 40'00" to 105 0 32'40" east. The province shares a border with Cambodia in the north; An Giang, Can Tho and Hau Giang provinces in the east and southeast, Ca Mau and Bac Lieu provinces in the south and Thailand gulf in the southwest. Kien Giang has a land area of just over 626,900 ha (Viet Nam Administrative Atlas), about 14% of the total Lower Mekong Delta in Viet Nam. There are 142 small islands as well as Phu Quoc Island with c. 58,000 ha, and 200 m of mainland coastline. Four of the 15 Districts are coastal.

A large and complex network of drainage canals has been established to control floods. In the period 2001 - 2003 the national government established four major canals from An Giang to Kien Giang. While assisting with flood control, these canals will contribute to the intrusion of salt water as sea levels rise especially in the dry season. Increased salinity levels were already observed in the dry seasons of 2009 and 2010 reaching up to 14 parts per thousand in some areas. This will affect agricultural production and the functioning of Melaleuca forests. In particular, it will severely impact on their important role as fish breeding areas.

As part of CCCEP, a new project in An Giang will begin in July 2011. The aim of this project is to improve water management in the agricultural landscapes and Melaleuca forests to increase the resilience of the ecosystems to climate change, as a contribution to poverty alleviation.

The coastline of Kien Giang is contiguous with that of Ca Mau. As part of CCCEP, a new project based in Ca Mau will also begin in July 2011. The project will build on the lessons learned in Kien Giang and apply a more strategic approach to effectively deal with the consequences of a changing climate. The project aims to enhance the ecological, social and economic resilience of the ecosystems and population of the local population. This will be achieved through the integration of climate change adaptation measures into provincial planning processes.

## 9

## ACID SULPHATE SOILS

Sea water intrusion into sediments deposited in the Mekong Delta about 4,500 years ago resulted in formation of potential Acid Sulphate Soils (pASS) that are now overlain by non acidic sediment. The regular flooding kept them continually saturated with water keeping them anaerobic and thereby preventing them from turning into actual Acid Sulphate Soils aASS. Large amounts of peat are also laid down in this condition under the melaleuca and mangrove forests that developed to cover much of the Delta.

Large scale conversion of these forests to other production systems – rice, aquaculture, horticulture – has occurred since the mid 1990s by development of a very dense network of canals which drain the flood water to the sea. These conversions result in large losses of carbon both from the trees and particularly from the peaty soils which contain much more carbon than the above ground vegetation. This drainage and subsequent land conversion is also responsible for conversion of some of the pASS to actual ASS which are very difficult to manage productively.

ASS contain iron sulphide minerals (pyrite) or their oxidation products such as jarosite and goethite. Once ASS are drained or exposed to air by a lowering of the watertable, the sulphides will react with oxygen to form sulphuric acid (the same product found in car batteries) and become toxic for plant growth and aquaculture systems built on the ASS or bordering them.

ASS cover more than 15 million ha of the tropics with about 6 million ha in Southeast and East Asia, 1 million ha in Viet Nam and about 8,200 ha of ASS were found in Kien Giang in 1975 (Tram and Lieu 1975), with a much larger area currently. Because the iron sulphide layers characteristic of ASS are formed under tidal conditions, ASS are commonly found in low lying areas near the coast. Potential ASS occur in much of Kien Giang.

Much of these soils have been developed or are under pressure for urban or agricultural development. Mechanical disturbance of the soils releases acid and dissolved heavy metals to create adverse environmental impacts: killing vegetation, acidifying ground and surface water making it unfit to drink, killing fish. These impacts are often long term and difficult, if not impossible, to reverse.

The conversion of soils to actual ASS resulting from a lowering of the water table in the dry season to below the sulphitic layer has the potential to devastate the rice and shrimp production on potential ASS.

A major problem arises from canal construction and dredging, the acid is leached by rainfall from the soil surface and drains into the canals where it is finally diluted out by the flood waters of the Mekong draining through the drains. Management of this acid removal process at the moment is very limited and ad hoc, relying on the natural flow processes to flush the acid out of the canals.

In Kien Giang coastal ASS are also likely to be saline making productive land use difficult as very few crops are able to survive in such situations. Each year most of the pASS of the Mekong Delta are flooded for 3 to 6 months to depths of 0.5 to 2.5 m. This maintains the anaerobic soil condition which prevents the formation of the sulphuric acid. Maintaining



the water table even in the dry season is also necessary. Climate change, increased extraction of water for irrigation and dams upstream for hydroelectricity on the Mekong are very likely to change these conditions.

What will happen if Climate Change or dams upstream cause less flooding? Lake Tonle Sap in Cambodia fills with water from the Mekong River in the rainy season from June to October and drains into the Mekong from November to May providing about 50% of the river flow into Viet Nam. Dams upstream and increased irrigation from Ton Le Sap are already affecting this water flow and if the water table in the Mekong Delta is not maintained then there is a great risk that pASS now used productively will be converted to the toxic, aASS.

Climate change may reduce the volume of water feeding into the Mekong River from glaciers upstream and the reduction in rainfall during the summer predicted with global warming for the Lower Mekong Basin in Viet Nam and the increased irrigation from Ton Le Sap is likely to affect water table levels, potential ASS conversion and saline intrusion. Project surveys show that productivity in horticultural, rice and rice-shrimp systems in some locations is already declining (through disease increase and/or increased acidity and salinity).

#### **Recommended management Solutions**

- Map locations of ASS so that appropriate management can be undertaken.
- Avoid development of ASS. The sulphuric acid in ASS can be neutralised by liming but this is very costly for large areas of badly affected land. Liming drains and canals can be effective in neutralising the sulphuric acid they contain.
- Maintain water cover over the soil to halt further acidification.
- Flooding with seawater will help neutralisation but can introduce other salinity complications.
- Forestry. Some valuable trees such as Melaleuca and mangroves will survive and grow well on ASS that are regularly flooded.
- Sea Water Neutralisation. Canal sluice gates can be used to allow seawater to neutralise acid drainage water, manage weeds and improve fish passage.
- Shallow Drainage. Wide, shallow drains allow surface water to drain quickly without exposing the sulphitic horizon.

The melaleuca forests of the Mekong Delta are a unique ecosystem that once covered most of the Delta. These forests are particularly well adapted to the very difficult soil conditions. It is imperative to keep and expand these forests. The project is developing ways to encourage farmers to do so. See sections 15, 20.

## DEVELOPMENT CONTEXT

Only about 22% of the population lives in urban centres. The province has had rapid recent economic growth with a 12.05% increase in GDP in 2009. The annual per capita income of \$ 1003 for the Province in 2010 is equal to the overall average for Viet Nam.

Kien Giang is a major sea based economy with more than 11,650 registered fishing boats with a catch of 473,494 tonnes in 2010, this is a 6.3% increase on 2009. The sector employs more than 60,000 people. The sustainability of the industry is likely to be an issue however, and the rapid increase in the fishing fleet is likely to have a major effect on fish stocks and the potential for crashes in populations is large.

Creation of Marine Reserves and no-take zones coupled with knowledge of stock sizes and a well regulated surveillance of catch sizes will be key to the sustainability of the industry. As well restoration of degraded coastal mangrove forests will be necessary to provide for the spawning of fish and other animals forming the basis of the fishing industry catch.

About fifteen years ago much of Kien Giang was covered by Melaleuca forest occupying sixty two per cent of the land area. In coastal areas there has been large scale land conversion from forest to rice production and then in turn converted to rice shrimp/fish production system and finally in the last few years many farmers have gone to shrimp monoculture. These land conversions have caused problems from acid production, relying on flood water to wash out the acid into the soil and the canals. Fish kills can result and failures of shrimp production systems are increasing.

One potential problem with the very large amount of fresh water being discharged into the sea from the canals draining the Mekong floods is that the sea salt levels are very much reduced and this is likely to have a big effect on the ecology of the coastal area especially of fish stocks.

An associated problem with the canal construction is salt water intrusion sometimes as far as An Giang. This again effects crop production. With climate change and rising sea levels this problem is likely to increase. Of the seventy one main canals opening to the sea only forty four have sluice gates to control sea water entry in the dry season when the Mekong floods are over and when there are unusually high tides.

Aquaculture, either as a mixed rice-shrimp-crab production system or shrimp ponds is increasing. The sustainability of aquaculture production will partly depend on the prevention of disease which has affected other countries such as Taiwan and Thailand. The Province is a major rice producer with 3.497.000 tonnes in 2010, ranking the first in the Mekong Delta Province production. Rice production is largely mechanised with contract ploughing and harvesting mainly with two crops per year.

The main inputs to the economy are from Trade, Tourism and Exports followed by primary production from Agriculture, Forestry and Fisheries. Tourism is increasing by about ten per cent per year mainly to Phu Quoc Island. This poses risks to the natural environment and biodiversity.

Kien Giang has 11,650 registered fishing boats



In 2010 there were 2.94 million tourists to Kien Giang with 95,500 International tourists. U Minh Thuong National Park as an important wetland and bird sanctuary attracts about 28,000 eco tourists a year. But Phu Quoc Island is the main venue for tourists with beautiful beaches bordered by sea grass and coral reefs. It has the best remaining dipterocarp forest in Viet Nam of about 12,000 ha. There are coral reefs and extensive sea grass beds which support the rare and endangered turtles and dugong. These are very important ecosystems for biodiversity but are also very important for tourism.

Fishing boats Phu Quoc island





## BIODIVERSITY IN KIEN GIANG BIOSPHERE RESERVE

The Kien Giang Biosphere Reserve (KGBR) is a very diverse environment with 6 main ecosystems and 22 different habitat types. There are 3 areas of land in the KGBR, U Minh Thuong National Park and coastal zone Protection Forests of An Bien and An Minh Districts, Hon Dat and Kien Ha Special Use and Protection Forest in coastal zones of Kien Luong and Kien Hai Districts and Phu Quoc Island and nearby 21 smaller islands.

### The main ecosystems and habitat types in KGBR are:

1. Primary and Secondary forest with domination of family (Dipterocarpaceae)
2. Limestone forest with domination of *Trestonia mergvensis* and *Dacrydium pierreii*
3. Melaleuca forests on acid lands
4. Mangrove forest
5. Coastal scrubland
6. Coral reef and seagrasses

The KGBR has significant biodiversity with about 1,500 vascular plants, 77 mammals, 222 birds, 107 reptiles and amphibian.

Twenty species have been identified as having special conservation priority including Roundleaf Cycad *Cycas litoralis*; Hairy-nosed Otter *Lutra sumatrana*, Jungle Cat *Felis chaus*, Fishing Cat *Prionailurus viverrinus*, Large-spotted Civet *Viverra megaspila*, Indochinese Silver Langur *Trachypithecus germaini*, Lylei's Fruit Bat *Pteropus lylei*, Large Flying Fox *Pteropus vampyrus*; Sarus Crane *Grus antigone*, Indian Darter *Anhinga melanogaster*, Lesser Adjutant *Leptoptilos javanicus*, Great Hornbill *Buceros bicornis*; Reticulated Python *Python reticulatus*, King Cobra *Ophiophagus hannah*, Yellow-headed Temple Turtle *Heosemys annandalii*, Malayan Box Turtle *Cuora amboinensis*, Snail-eating Turtle *Malayemys subtrijuga*, Asiatic Softshell Turtle *Amyda cartilaginea*; Green Sea Turtle *Chelonia mydas* and Hawksbill Sea Turtle *Eresmochelys imbricata*.

### Four forest types and plant communities have been identified as special priority for conservation.

1. Dwarf forest on sand hills in Phu Quoc Island
2. Near monospecific stand of the mangrove *Lumnitzera littoraea* in the Rach Tram estuary, Phu Quoc Island. The trees are very large 10-15 m tall with diameter 30-60 cm and up to 1 m. The species is listed as vulnerable in the Viet Nam Red Book of Endangered Species
3. Melaleuca forest on peat land in U Minh Thuong NP and elsewhere in Kien Giang.
4. Coastal mangrove forest

There is 700 ha of coral with 87 species, nearly half are hard corals making up to 24% of the coral area. The corals occupy up to 40% of the reef areas. There are 12,000 ha of sea grass beds (10 species) which support the rare and endangered turtles and dugong. These are very important ecosystems for biodiversity but are also very important for tourism particularly on Phu Quoc Island.

A major problem with biodiversity conservation in the KGBR is wildlife hunting and trade. For example, project surveys found more than 26 species of snakes within shops for sale. The project is addressing through the awareness campaign and through training for protected area staff.



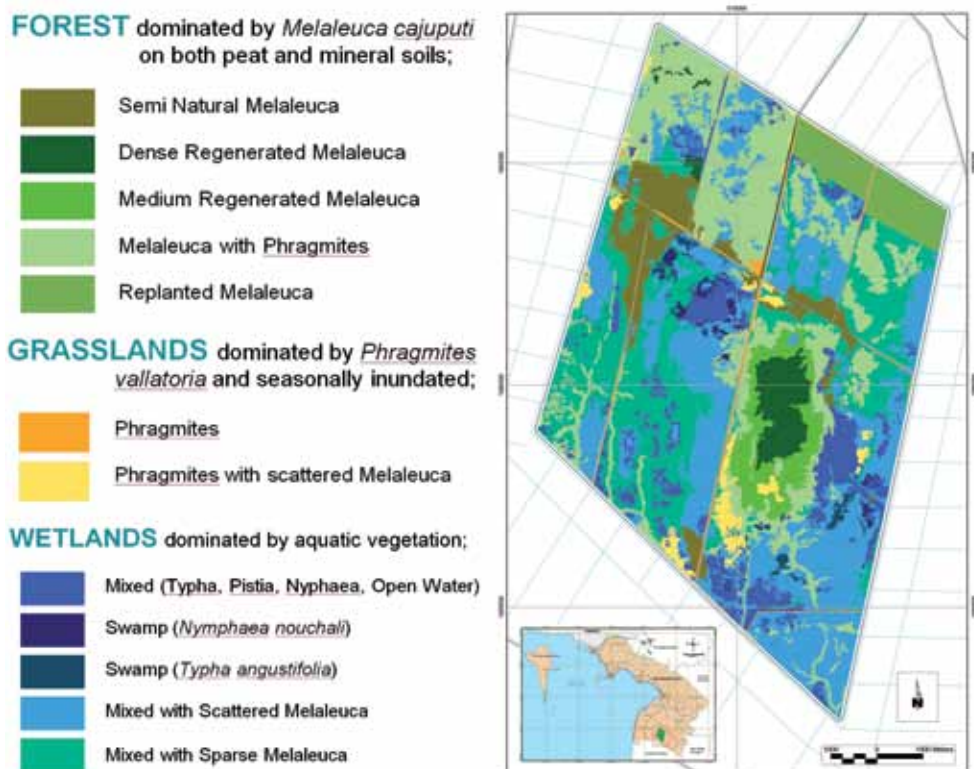
## U MINH THUONG NATIONAL PARK

U Minh Thuong National Park (UMT NP) is one of two large areas of peat swamp forest remaining in Viet Nam, the other being the nearby U Minh Ha National Park in Ca Mau Province. Their conservation has the highest National priority because they buffer the effects of the Mekong River floods, recharge aquifers and provide a unique environment for many wetland species. The Park was established in January 2002 from a Nature Reserve previously established because of the historical and cultural importance of the area, with a total area of 8.038 ha and with a buffer zone of 13.069 ha. The Park was a base for resistance forces during the First and Second Indochina Wars.

It is home to much biodiversity including 243 plant species, 32 mammal, 151 bird, 34 reptile, 7 amphibian, 34 fish and 181 insect species. Forty of these are listed as either rare or endemic species listed as endangered species in the Viet Nam Red Book and by IUCN. Of the 7 vulnerable mammal species the Hairy-nosed otter (*Lutra sumatrana*), Small clawed otter (*Aonyx cinerea*), Large spotted civet (*Viverra megaspila*), Fishing cat (*Prionailurus viverrinus*), Lyle's fying fox (*Pteropus lylei*) and Large flying fox (*Pteropus vampyrus*) are of special conservation priority as UMTNP has the largest or second largest populations of these species in Viet Nam.

There are several endangered species: Grey-headed Fishing Eagle (*Ichthyophaga ichthyaetus*), Greater Spotted Eagle (*Aquila clanga*), Indian Darter (*Anhinga melanogaster*), Lesser Adjutant Stork (*Leptoptilos javanicus*), Woolly-necked Stork (*Ciconia episcopus*), Asian Golden Weaver (*Ploceus hypoxanthus*), Yellow-breasted Bunting (*Emberiza aureola*), Indian Darter (*Anhinga melanogaster*), Lesser Adjutant Stork (*Leptoptilos javanicus*), Javanese Cormorant (*Pharacrocorax niger*).

The main habitat types are described in the map below:



There are 8 species of economically important fish living in the park including the rare Sac Ran fish which grows within the melaleuca forest. The Project is supporting a program to cultivate the fish in the buffer zone (section 20). There are 2 rare species of otter that capture visitor's attention. Nine of the extraordinarily diverse population of bird species are globally rare.

#### **National Workshop on water and fire management**

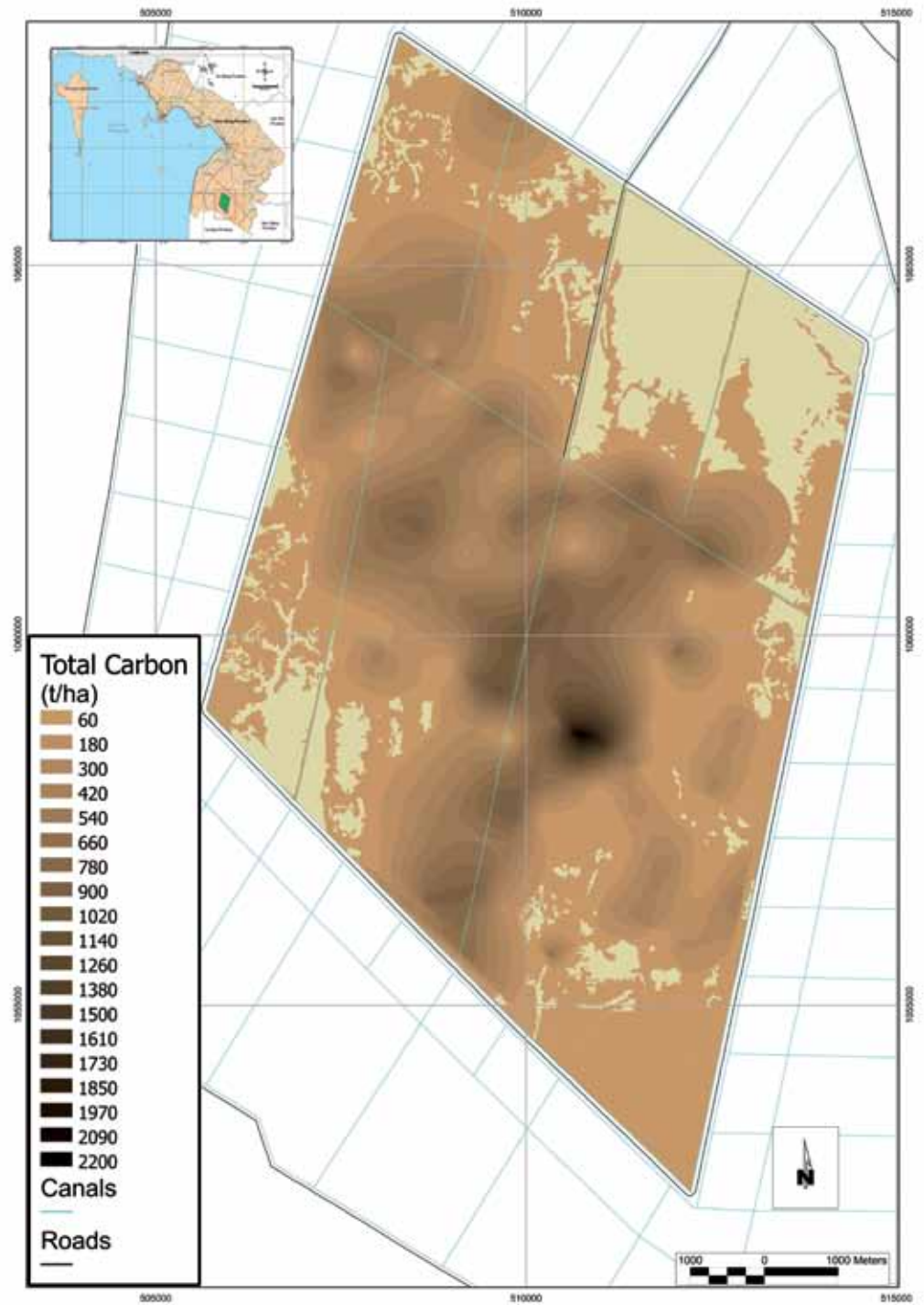
In the March 2002 dry season (just two months of the declaration of the NP), an intense fire burned over 3,000 ha of the forest and the underlying peat. After this fire event, water was permanently held in the park and this led to severe damage to the biodiversity. The Ministry for Agriculture and Rural Development (MARD), Kien Giang Province Peoples Committee, the Kien Giang Department of Agriculture and Rural Development and UMT NP were supported by the Project in running a two day workshop in November 2009 on "Conservation and sustainable development for UMT National Park". The workshop was the first step in designing water, fire and biodiversity management plans for the Park.

The workshop was chaired by MARD Vice Minister of Mr Hua Duc Nhi, and the 110 participants included the Vice chairman of Kien Giang PPC, Mr Lam Hoang Sa, Leaders of the MARD Forest Protection Department and Forestry Department, scientists and researchers from 5 universities, Sub Forest Science Institute of Viet Nam, Sub Forest Inventory and Planning Institute, the Southern Institute for Water Resources Planning and the Institute for Water Resources Research, Department staff from 5 Provinces, representatives from 5 National Parks and Protected Areas, Protection Forest Management Boards, from 2 buffer zone communes of UMT NP, and from WAR and WWF.

The workshop decided that action had to be taken immediately to change the fire control management system through flooding currently in operation. As part of the workshop decisions, the Project committed to support the development of the new NP Management Plan, establishment of a technical advisory group, capacity building for NP staff, development of a contour and soil map for supporting management decisions, and a program to monitor the effects of the new water management system on biodiversity. All of these activities have started and will be completed by December 2011.

Fire is a serious threat to the melaleuca forest on the peat land. The current depth of the peat has been measured, mapped and the carbon content estimated (see section 12). In order to prevent further fires a water management system was established that flooded most of the Park throughout the year. This prevented regeneration of much of the biodiversity. As a result of the National Workshop, a decision was made by the NP Management Board to stop the flooding in the dry season but maintain enough water in the canals to keep the soil moist. A dramatic flourishing of the plant species including melaleuca resulted within 3 months and now the bird population has increased by 30% and 9 additional species have been recorded. It is expected that bird numbers will increase significantly in September/October this year (2011) during the breeding season.

Water levels in the Park are managed through a perimeter system of canals and dykes, with a series of gates and internal canals. A new water management scheme is being developed which reduces fire risk but allows biodiversity to flourish.



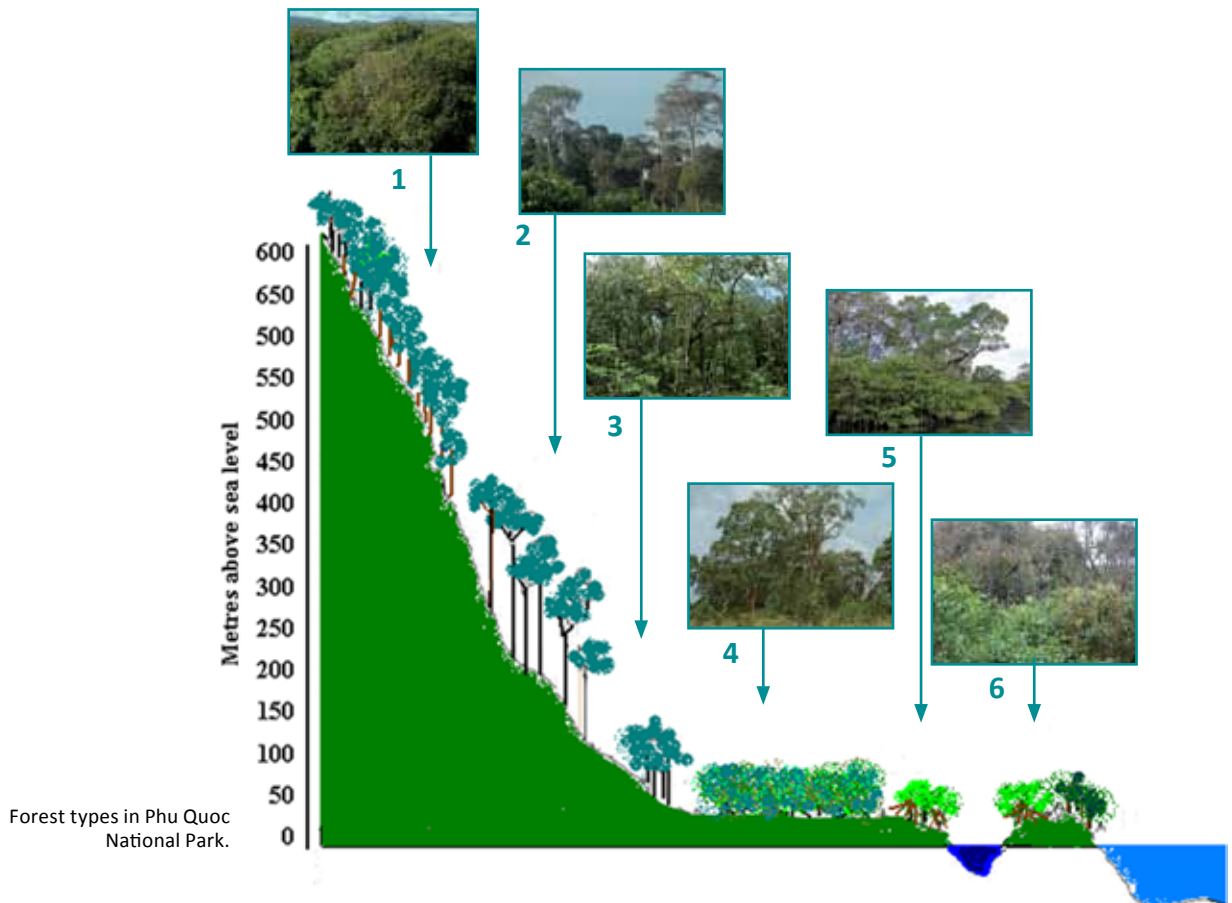
Peat map of park is being used for fire management and as an estimate of the carbon value of the forest.



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PHU QUOC ECOSYSTEMS

Phu Quoc island lies in the Gulf of Thailand, about 40 km due west of the Vietnamese mainland. Phu Quoc National Park is situated in the north-east of the island. The topography of the national park is hilly, although not particularly steep. The highest point in the national park is Mount Chua at 603 m. The National Park has the best remaining, least disturbed Dipterocarp forest in Viet Nam of about 12,000 ha. There are some very valuable tree species of conservation concern *Fagraea fragrans*, *Anisoptera costata*, *Dipterocarpus grandifolius*, *Hopea pierrei*, *Hopea ferrea*, *Dalbergia cochinchinensis*, *Dysoxylum cauliflorum*, *D. loureiri*. The area is very diverse with 6 forest types and 1,171 species of vascular plants.





In addition to its rich forests, Phu Quoc has extensive corals and seagrass beds, 61 mammal species, 134 species of birds, 23 species of amphibian and 55 species of reptiles. Of these 25 plant species, 14 mammal species, 5 bird species and 23 reptile species are of threatened and listed in the Red Book.

Phu Quoc National Park (31,422 ha) established in 2001 in the north of the Island, has an elevation ranging from 0-603 m asl. The dwarf forests on sand hills with small timber trees about 5m high at an altitude up 10m asl are rare in Viet Nam and do not readily regenerate and along with the stand of *Lumnitzera littorea* also in the NP are of special conservation priority. Two planned tourism developments comprising 542 ha threatens their existence.

The marine biodiversity in the KGBR has been little documented. This is severely threatened with the increase in ocean capture fishing and the incursion into the mangrove forests by aquaculture and the loss of mangroves from sea level rise effects and the turbulence associated with the canal outlets.

Land use conversion and incursion into the National Parks threatens their integrity and the biodiversity they contain. The Project is seeking to improve livelihoods in the buffer zone to counteract this.



Phu Quoc mangroves in foreground and melaleuca



## COASTAL FORESTS

Forests of the native *Melaleuca cajuputi* and the introduced *M. leucodendra* from Australia can be sustainably managed to provide poles and timber (see section 15). Thus melaleuca forests benefit the environment by storing carbon and by helping prevent the development of acid soils. U Minh Thuong National Park has a large area of melaleuca forest where degradation following fire is being addressed by the Project (see section 12). State owned Forest Companies have large areas of Melaleuca also.

Mangrove forests (about 3000 ha) and the dipterocarp forests on Phu Quoc island (about 12000 ha) are the other major areas of forest in Kien Giang. Mangrove forests are salt-tolerant forests that grow in coastal belts between land and sea, with at least 27 of the 39 known species in Viet Nam occurring in Kien Giang (see section 16). They grow in tidal areas along the coast, and as fringing stands along the canals, especially near the sea entrances. Mangrove forests have multiple functions: as barriers against sea incursion especially with rising sea levels, against increasing numbers of severe storm events and saline water intrusion, as carbon sinks in plant biomass and soil and sediments, provision of timber, and maintenance of marine animal biodiversity, especially as a nursery for fish, prawns, shrimps and crabs. Much of the coastal fish catch relies on mangroves to provide shelter for young fish and shrimps.

Mangrove forests have been degraded by general disturbance, cutting, chemical pollution, poor growth and altered drainage. Depleted mangrove areas have also been converted to aquaculture especially shrimp ponds, to crop production and industrial development. Sea erosion and sea level rise have caused the recent loss of large areas of mangroves and coastal land of up to 29 m per year. Degraded mangrove forests are not able to protect the coastline and breaches in the dykes are occurring as a result. The Kien Giang Peoples Committee realises that loss of mangrove forests will result in significant environmental damage to the coastal region and has established Coastal Forest Management Boards to protect and rehabilitate mangrove forests.

Thus there are very good reasons for the Kien Giang Province to rehabilitate and increase the area of forests in order to adapt to climate change and to develop a REDD+ project to provide the much needed finance through Payment for Environmental Services (PES).

We have estimated that Kien Giang mangrove forests are storing 450,000 tonne Carbon, U Minh Thuong National Park is storing 237,667 tonne in the melaleuca forest but substantially more in the peat – 1,812,344 tonne.

### Estimate of carbon being stored in some of Kien Giang's forests

	Area (ha)	Carbon (t)	CO <sub>2</sub> equivalent (t)
Peat in UMT	3,909	1,812,344	6,651,302
Melaleuca in UMT	6,970	237,667	872,237
Mangrove forest	1,210	450,000	207,300
<b>Total</b>	<b>12,089</b>	<b>3,907,355</b>	<b>7,730,839</b>



## IMPROVING PRODUCTIVITY AND PROFITABILITY OF MELALEUCA FORESTS

Although greatly reduced, melaleuca forests still play a very important role in local economies and confer considerable environmental benefits to the region. Production forests of melaleuca comprise 3.9% (24,421 ha) of the total area of Kien Giang. Within Kien Giang province there are now 42,970 ha of Melaleuca forests. These include 9,540 ha of Protection Forest and 33,430 ha of Production Forest.

### The forests play an important role by providing:

- A source of wood for construction and fuel
- Handicraft materials, oil, honey, medicinal plants and other minor forest products
- Suitable habitat for fish and other aquatic life
- Prevention of acidification of topsoil and surface water
- Storage and renovation of fresh water
- Storage of carbon
- Flood and erosion mitigation
- Maintenance of biodiversity
- Aesthetic values
- Venues for recreation and relaxation.

Melaleuca species are the only ones able to produce timber without extensive site disturbance which invariably leads to extensive environmental damage through the release of acid into the environment and waterways. *Melaleuca cajuputi* is the naturally occurring species in the Mekong but a closely related species *Melaleuca leucodendra* has been introduced from Australia and grows faster in some soils and may be more suited to saw log production.

### Future prospects for melaleuca

Traditionally, melaleuca has been grown at very high stockings (10,000 stems/ha or greater) to produce large numbers of small size posts and poles for use in general construction. However, today the financial risk associated with growing melaleuca forests for pole production is high. While there is no payment for environmental services or social benefits to the private grower or Forest Enterprise for establishing and managing melaleuca forests for timber production, land use conversions are likely to continue unless improved silvicultural technology is introduced to improve productivity and profitability of melaleuca plantations.

The project is exploring ways to provide financial incentives for farmers. There is growing interest in growing melaleuca for high value markets such as sawlogs and veneer logs. Melaleuca timber is attractive and suited for high value end uses such as furniture manufacture. The project is currently working to design some samples with a furniture company in HCM City. Given the global increase in area of conservation and protection forests and the move towards forest certification, the price of high value rainforest timbers is expected to escalate creating an opportunity for growers of melaleuca to capitalise on the growing demand for solid timber for high quality use. One of the major limitations for high value uses of Melaleuca is the small log size available, but there are economically attractive prospects for melaleuca sawn wood. At present, there is an almost total lack of material of sufficient size suitable for sawmilling.

Understanding of new silvicultural methods is urgently required to increase the productivity and profitability of melaleuca plantation production of sawlogs. Radically different silvicultural regimes need to be tested and demonstrated, especially spacing and thinning to produce fewer, large size, defect free, trees per unit area. Improved establishment techniques are also needed if large stems are to be produced in relatively short rotations.

The project has set up and is monitoring the following silviculture demonstrations

**A Melaleuca thinning demonstration** is quantifying the effects of five different thinning intensities of 7 year old stand of *Melaleuca cajuputi* growing in severe acid sulphate soil. The thinning treatments retained 1000, 2000, 4000, 8000 and 13400 stems/ha. The demonstration will be used to show farmers the benefits of thinning to produce larger size trees expected to command a much higher value in the predicted markets of the future.

This trial has shown that heavy thinning of a seven-year old stand resulted in a **96% increase in basal area over a 17 month period.**

**A Nelder Wheel/Fan demonstration** provides a simple, efficient means of measuring the impact of stocking rates on tree growth and development. The technique is easy to establish, requires few trees to plant and a small land area is needed. The initial planting densities range from 303 to 63,463 stems/ha. The initial results show that mean height of all trees increased from 21.9 cm at the initial measure to 179.4 cm in December 2010 (age 16 months). **Height increment for the trees averaged 11.2 cm per month.**

**Melaleuca Fertiliser Demonstration.** There is little published information on effects of fertilising on the growth, size and form of melaleuca plantations needed to develop commercially viable plantations of larger sized trees. Identification of limiting nutrients and interactions between applied nutrients for representative sites is critical to designing cost efficient fertiliser regimes. Fertiliser can be an expensive option in forestry practice. All too often, compound fertilisers are applied without any effort to determine which element/s are in limited supply.

The project established a demonstration where two rates of N, P, K, a trace element mix and lime was laid out as 64 plots.

Results show that **over an 11 month period, Nitrogen improved tree height by 28%.** The lime treatment has been effective in improving soil pH, in particular of the surface 0 - 2 cm soil layer, yet no response in terms of tree growth was recorded.

The area of degraded acid soil will increase with climate change and due to deforestation



Acid runoff causes change to water quality. Brown water is pH 7 while the blue water is pH 4

Melaleuca timber can be used for making fine furniture and for flooring



Melaleuca is the only tree species that can grow in acid sulphate soil





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## ASSESSMENT OF THE COASTAL MANGROVE FORESTS

In 2008, the Kien Giang coastline was assessed using the Shoreline Video Assessment Method (SVAM) developed at the University of Queensland. The video was analyzed for a number of features that relate to the 'condition' of the coast. Simultaneous GPS data enables shoreline features to be mapped. SVAM gives qualitative assessments of shoreline habitat, physical condition and human influence from continuous video recordings of the shoreline and intertidal zone of the entire shoreline of Kien Giang Province.

The mangroves of Kien Giang Province in South Viet Nam are a highly valuable resource. A project survey identified 27 species. Table below.

Local Name	Latin Name	Phu Quoc	Ha Tien	Kien Luong	Hon Dat	Rach Gia	Chau Thanh	An Bien	An Minh	Kien Giang	Viet Nam
Ô rô trắng	<i>Acanthus ebracteatus</i>				1					1	1
Ô rô tím	<i>Acanthus ilicifolius</i>	1	1	1				1	1	1	1
Ráng	<i>Acrostichum aureum</i>	1	1	1	1		1	1	1	1	1
Ráng	<i>Acrostichum speciosum</i>	1	1		1	1	1	1	1	1	1
Sú	<i>Aegiceras corniculatum</i>	1	1	1	1					1	1
Sú đỏ	<i>Aegiceras floridum</i>										1
Mắm trắng	<i>Avicennia alba</i>	1	1	1	1	1	1	1	1	1	1
Mắm biển	<i>Avicennia marina</i>	1	1	1	1	1		1	1	1	1
Mắm lười đòng (Mắm đen)	<i>Avicennia officinalis</i>		1					1	1	1	1
Mắm quăn	<i>Avicennia rumphiana</i>										1
Tim lang	<i>Barringtonia racemosa</i>										1
Vẹt trụ	<i>Bruguiera cylindrica</i>		1		1	1		1	1	1	1
Vẹt dù	<i>Bruguiera gymnorhiza</i>	1		1	1	1				1	1
	<i>Bruguiera hainesii</i>										1
Vẹt tách	<i>Bruguiera parviflora</i>										1
Vẹt khang (Vẹt đen)	<i>Bruguiera sexangula</i>	1	1	1	1		1	1	1	1	1
Dà quánh	<i>Ceriops zippeliana (C.decandra)</i>	1	1	1				1	1	1	1
Dà vôi	<i>Ceriops tagal</i>	1		1				1	1	1	1
Quao nước	<i>Dolichandrone spathacea</i>		1					1	1	1	1
Giá	<i>Excoecaria agallocha</i>	1	1	1	1	1	1	1	1	1	1
Cui biển	<i>Heritiera littoralis</i>	1	1	1	1		1	1		1	1
Trang	<i>Kandelia candel</i>										1
Trang	<i>Kandelia obovata</i>										1
Cóc đỏ	<i>Lumnitzera littorea</i>	1	1		1					1	1
Cóc vàng	<i>Lumnitzera racemosa</i>	1	1	1	1			1	1	1	1
Cóc hồng (cây lai)	<i>Lumnitzera X rosea</i>										1
Dừa nước	<i>Nypa fruticans</i>	1	1	1	1	1	1	1	1	1	1
	<i>Pemphis acidula</i>										1
Đước (Đước đôi)	<i>Rhizophora apiculata</i>				1	1	1	1	1	1	1
	<i>Rhizophora X lamarckii</i>	1	1	1							1
Đưng (Đước bộp)	<i>Rhizophora mucronata</i>	1						1	1	1	1
Đâng (Đước vôi)	<i>Rhizophora stylosa</i>										1
Côi	<i>Scyphiphora hydrophyllacea</i>	1	1	1						1	1
Bần trắng	<i>Sonneratia alba</i>	1	1	1	1			1	1	1	1
	<i>Sonneratia apetala</i>										1*
Bần chua	<i>Sonneratia lanceolata (=S. caseolaris)</i>	1	1		1	1	1	1	1	1	1
Bần ổi	<i>Sonneratia ovata</i>	1	1	1	1	1		1	1	1	1
Xu ổi	<i>Xylocarpus granatum</i>	1		1				1	1	1	1
Xu mekong	<i>Xylocarpus moluccensis (ex X. mekongensis)</i>		1						1	1	1
	<b>TOTAL SPECIES</b>	<b>22</b>	<b>22</b>	<b>18</b>	<b>18</b>	<b>10</b>	<b>9</b>	<b>21</b>	<b>21</b>	<b>27</b>	<b>39</b>

Mangrove plant species in Kien Giang Province, including sites in Phu Quoc, Ha Tien, Kien Luong, Hon Dat, An Bien and An Minh districts, compared with all Viet Nam (Hong 2004; Nam 2008; Duke pers. Observations).

\*Introduced.



These unique coastal forests provide multiple ecosystem services including; carbon storage, wood production for building, fish trap construction and firewood, habitat for aquatic food resources and most importantly shoreline stability and erosion reduction. Increased fragmentation of these forests has reduced their capacity to withstand physical processes such as wave action, coastal currents and wind that are related to their location on a semi-exposed coastline. Consequently large areas of coastline are currently eroding or are at risk of erosion in the near future.

This coastal erosion problem is not only removing the mangrove resource and associated ecosystem services, but directly threatens the livelihoods of numerous people and greatly increases the vulnerability of Kien Giang Province to the effects of sea-level rise and storm surges predicted with climate change. To achieve effective coastal protection it is necessary to assess and quantify the current condition of the shoreline and the mangrove resource in order to identify, locate and quantify the full extent of the issues that directly threaten mangroves and reduce their resilience to coastal erosion processes.

#### **The shoreline video assessment method (SVAM)**

In February 2009 a video of the shoreline was taken using a Sony Handycam from a boat running parallel to the coastline approximately 25m from the shore. A GPS was used to record latitude and longitude every 3 seconds. Video of the coastline was reduced to 1 second frame .jpg files. The shoreline features in each frame were then scored. Only the initial 20m intertidal zone visible in the frame and/or the directly adjacent terrestrial habitats (if visible) were used for assessment.

Video recording coastline of Kien Giang



Coastline erosion was assessed



The aims of the rapid video assessment were to:

- Quantify shoreline physical condition – substrate and erosion.
- Categorize and quantify shoreline mangrove forest type, extent and condition.
- Identify and quantify shoreline mangrove resource use.
- Identify and quantify threats to the shoreline mangrove resource.

The SVAM enables a rapid, cost-effective assessment of shoreline condition that requires little expertise for data collection, enables detailed assessment of shoreline features and is repeatable for future monitoring purposes. The use of video provides a permanent record of shoreline condition from which to assess future change. Detailed results are available in a project report by Dr Norm Duke.

**Topics covered include:**

- Shoreline Mangrove Habitat Types
- Shoreline Erosion
- Exposed Mud Walls/dykes
- Mangrove Forest Structure
- Mangrove Species
- Mangrove Biomass.and carbon
- Mangrove Planting
- Shoreline mangrove forest type, extent and condition
- Mangrove resource use
- Mangrove Cutting
- Mangrove planting activity
- Threats to Mangroves

**Spatial information**

As the data was collected as a continuous line intercept, it is possible to produce maps showing combinations of characteristics of the shoreline. Maps are now available showing the vulnerability of stands and areas requiring extra conservation management can now be defined. Maps have also been produced for rehabilitation studies, the maps have been used to define the extent of lands at risk to prioritize restoration works.

The results of this study were used by DARD and Sub Forestry Inventory and Planning Institute in the design of the provinces coastal restoration plan for 2010 to 2015.

## INNOVATIVE 7:3 POLICY FOR MANGROVE PROTECTION

Kien Giang PPC is piloting an innovative approach to balancing mangrove conservation with livelihood improvements. This involves increased land allocation or land contracting to individuals, households, and groups, in exchange for high levels of forest and mangrove conservation on the contracted land. Under Decision 51, also called the 7:3 policy, forest protection Management Boards enter into long-term contracts with individuals and households to protect and use the forest. Contractors are required to maintain 70% of contracted land under forest cover, and are encouraged to use the remaining 30% of the land and surface water for agriculture, aquaculture, and other income-generating activities. The 7:3 policy applies in mangrove and terrestrial forests, and has special provisions that apply in mangrove areas.

The policy provides benefits to local people in the form of use rights in protection mangrove forests that they would not otherwise have. The policy may also permit private PES in the 30% of contracted land provided for income-generating activities. This kind of mechanism, which combines non-monetary incentives, encourages limited economic development, and which may be compatible with private PES, is an interesting approach to the problem of high opportunity costs for conservation. The policy is now in its pilot phase in two districts (An Minh and An Bien). If successful, it may represent a promising option for mangrove conservation and PES in Viet Nam.

In the five years since Decision 51 was passed, 490 households (or 52.5% of the 932 eligible households) have participated. The policy has received the strong support from Forest Protection Management Boards, local authorities and local people. Many households took advantage of the program to invest in expanded aquaculture, and are now earning increased income from shrimp, blood shell culture, and fish farming. At the same time, forest cover has increased by 20%, according to the An Minh-An Bien Forest Protection Management Board. However, there is evidence from project surveys that local people tend to develop more than 30% of contracted land, reducing the proportion of the forest that is conserved. This underlines the importance of strong enforcement to the success of this innovative policy.

Mangrove forests in Kien Giang are categorized as protection forest. Under Decision 51, the Kien Giang provincial People's committee assigns direct management of these forests to Forest Protection Management Boards. The Management Boards then act as forest owners, implementing all protection, plantation, and management activities and entering into protection contracts with local people.

Forest protection contractors are given a long-term (50 year) interest in contracted land, during which time they are ensured rights and benefits from the land. They receive compensation for labour and investment costs and they have the right to pass their contractual use rights to their heirs or transfer their rights during the period of the contract. In addition to encouraging economic use of 30% of contracted land, the policy supports local people in expanding or merging existing canals and fish ponds in order to overcome the disadvantages associated with small land holdings and limited access to production land and surface water.



Any harvesting, thinning, canal dredging, and other land use changes must be reviewed and approved by the Department of Agriculture and Rural Development and supervised by the Forest Protection Management Board, the commune People's Committee, and forest rangers.

One key lesson, apparent at both the national and local levels, is the importance of improved coordination between land and forest management authorities. Another is the importance of balancing mangrove conservation with economic development. The challenges of mangrove conservation also highlights the need for an approach that uses all available tools, including command-and-control regulation, PES, and monetary and non-monetary compensation. Finally, variation between the sites in terms of mangrove extent, density, and quality, mangrove species composition, drivers of mangrove loss, and local law and politics show the need for approaches that can be adapted to local circumstances.

As shown at the local level, it will be vital to the success of PES and mangrove conservation in Viet Nam to strengthen collaboration amongst decision makers, management authorities, and stakeholders on mangrove forest protection and development. Cross-commune management boards may be needed in some circumstances, in order to facilitate inter-commune coordination and communication with respect to mangrove management and to prevent "leakage" of harmful activities between communes. Sectors, particularly agriculture and rural development and natural resources and environment, must work closely together in mangrove regulation, where there is extensive jurisdictional overlap. Co-management models, which involve stakeholders in the decision-making process, can increase buy-in and coordination while lightening the State's burden in terms of managing and administering forest resources.

Second, successful mangrove conservation initiatives must address the fact that mangrove loss is largely driven by economic development. If mangrove conservation continues to be seen as a zero-sum trade-off with development, mangrove conservation will not be prioritized by the government or by local stakeholders. Decision 51 in Kien Giang is interesting in that it encourages forest contractors to use up to 30% of contracted land and surface water to develop aquaculture and agriculture, thereby generating significant income. As long as 70% of the land is maintained as standing forest (or replanted with new forest), these activities should support the livelihoods of local people in a way that is consistent with long-term mangrove conservation. Similarly, PES can help to provide economic opportunities that are based on, rather than antithetical to, mangrove conservation. This type of harmonization between conservation and development is very important in Viet Nam.

## COASTLINE PROTECTION AND FENCES

Kien Giang Province has 205 km of coastline and it is estimated that at least 25% of this coastline is badly eroded. This shoreline has more than 5,000 ha of mangrove protection forests, forming a thin green line of salt-tolerant vegetation that buffers and protects valuable farming lands from rising seas and storm damage. This tacit coastal defence is threatened by global climate change, as predicted rises in sea levels take effect.

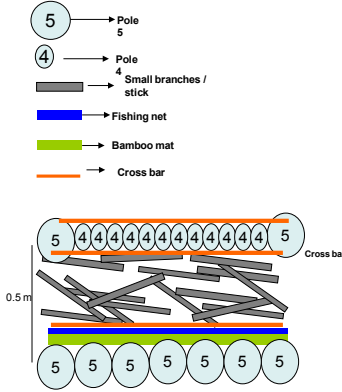
Communities need to delay and minimise the inevitable impacts of climate change. A strategy of 'buying time' requires action now. A wide, dense forest of healthy mangroves along the shoreline is needed to break the force of waves and storms that would otherwise erode them. So, coastal mangrove forests should no longer be removed or damaged in any way. Strategies and methods are required urgently to rehabilitate all threatened coastal shorelines.

Forest restoration under the 661 program is being implemented in Kien Giang by Department of Agriculture and Rural Development (DARD) and Forest Protection Management Boards (FPMB) and they have planted 345 ha, but this work has only focused on planting single mangrove species (*Avicennia alba* or *Rhizophora apiculata*) at the depositional areas and only 50% of these have survived. Previous efforts on planting mangroves in high erosion sites failed. Reasons for these failures are poor species selection, poor quality seedlings and a lack of protection of seedlings from mechanical forces during the critical initial stages of growth following planting.

In the wet season SW winds blow from the sea towards the land and this pushes waves towards the dykes which cause general erosion and breaches of the dykes. In this season silt is deposited along the coastline. In the dry season the NW winds blow from the land towards the sea. At this time some of the silt is removed along the coastline or moves out to sea.

The project has developed a series of measures to protect the seedlings and increase the likelihood of successful mangrove replanting.

**Legend:**



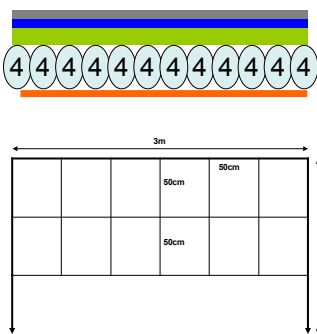
**Wave barrier fence**

**A mangrove forest reduces wave energy by 50 - 67% depending on forest structure. The wave barrier fence reduces the wave energy by 64 - 66%.**

In Kien Giang the foreshore is shallow and the waves are not high or strong, nonetheless they are causing high rates of erosion with up to 25 m being eroded annually from some areas. One major impediment to the successful establishment of mangroves is wave action. The main function of the wave barrier fence is to reduce wave action. The design also traps some silt at the end of the wet season and excludes rubbish from the foreshore. The design is shown below. The current cost for this fence is 16,866 USD/Km.



Design for silt trap fence: Style 1



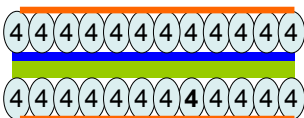
**Silt trap fence**

**The silt trap fence design reduces wave energy by 60%.**

Another impediment to successful establishment of mangroves is the change in silt deposition with seasons. The silt can smother mangroves in the dry season and will be eroded from small root systems of seedlings during the wet season. The design of the silt trap fence is shown below. The main function of the silt trap fence is to keep or trap silt deposited in the wet season and from being washed into the sea during the dry. This fence also reduces wave energy, and excludes rubbish from the foreshore. The current cost for this fence is 16,444 USD/Km.

Design for silt trap fence: Style 2

**Seaward side**



3m = 39 poles 4 x 2 rows = 78 poles 4



These fences are being used by the forest protection management board. A project manual that gives detailed instructions on the uses, construction techniques and costings of these fences is available.

The project has been monitoring the effects of these fences on the local ecology. Please refer to the maps that describe the different treatments that are based on the type of fence protection provided to the new seedlings.

### Treatment map



	Control	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Natural mangroves
	No fences	1 fence	2 fences	Mangrove + 1 side fences	Mangrove + 2 side fences	
Annual silt gain (cm)	0	0	4	10	9	nd
Survival planted mangroves (%)	na	30%	90%	100%	100%	na
Growth planted mangroves (cm)	na	little	60 cm	80 cm – Recruited plants 150 cm	80 cm – Recruited plants 100 cm	na
Recruitment	None	After 2 years low number. At 3 years estimated at 1-5 seedlings m <sup>2</sup>	After 1 year medium number; at 3 years estimated at 20 – 500 m <sup>2</sup> .	Immediate – medium numbers. Medium growth. At 3 years outgrowing planted seedlings	Immediate – large numbers. At 3 years outcompeting planted seedlings	Large numbers of young seedlings
Benthos – Species richness	4	3	7	5	5	8
Benthos – species abundance (Molluscs & Crustacea)	6	51	57	86	45	88

In addition to the obvious benefits of the fences in reversing the erosion process, is the level of natural recruitment, particularly of *Avecenia* species. This could have important cost implications for restoration programs, particularly in deposition areas. The demonstration has shown that as soon as the soil stabilises, *Avecenia* will establish naturally and these will out-compete planted seedlings. In high erosion areas the soil needs from one to two years to stabilise enough for natural recruitment.

### Production of mangrove seedlings

Our demonstration has taught us that mangrove seeds are best planted directly into the planting site. Naturally recruited mangroves have grown three times as fast as the planted seedlings. Seeds use their stored energy reserves in early growth and will slow down as they adjust to new conditions if transplanted.

For logistical reasons it is often necessary to grow seedlings in nurseries. Around 30 species of salt-tolerant mangrove plants are plentiful around the Kien Giang coast, so there is a ready supply of suitable propagation material. The project has been collecting seed from a range of species and we now grow 10 species including three rare species, *Lumnitzera littorea*, *Lumnitzera racemosa* and *Xylocarpus granatum*. They are planted to increase the biodiversity in restoration areas.

We have used two types of nursery. The first was set up opposite the dyke wall. Seeds or seedlings were planted in 15 cm diameter plastic bags filled with mud and silt from the intertidal zone and placed in a screen house with approximately 50% shade provided by shade cloth or fish net. In the nursery they need to be watered twice daily with salt water and need exposure to direct sunlight before planting. They are ready to transplant after about 2 months.

The second nursery was set up in a natural intertidal location. Existing trees were pruned to allow sunshine. The change in the tides water the plants, saving labour costs. Melaleuca poles were used to keep our wave energy and prevent rubbish accumulation.



Simple nursery using shade cloth.

Low cost nursery  
taking advantage of  
the natural conditions





## SEA DYKE CONSTRUCTION

The Province and District authorities have repaired eroded sections of the dyke in the past but these efforts have often failed. The project and the Department of Dyke construction of DARD have examined and documented current dyke construction practices. Material for construction of sea dyke is generally excavated from an area within 10 m of the foot of the dyke. It is often excavated from both the sea side of the dyke and from the inland side. The result of this practice is that a trench is created along the seaward toe of the dyke. The soil material used to create the dyke is thus a mix of organic material, gravel and clay.

### **Effect of current practice on future erosion**

Erosion will occur wherever there is a change or modification of the natural sea bed such as has occurred with the construction of dykes. The extraction of soil from the front of the dyke, combined with exposure to strong currents appears to be the cause of the erosion of the foreshore. The trench constitutes a vulnerable area for erosion which can take place as outgoing waves cause turbulence within the trench. The turbulence gradually destroys the slopes and creates more erosion channels in the sediment of the foreshore thus destroying the mangrove trees. Once this has happened, the erosion channels and mangrove destruction will expand rapidly as seawater turbulence enters adjacent areas through the trenches that exist behind the mangroves. This means that in the adjacent forested areas, part of the backflow will not pass through the mangroves but will follow the path of lowest resistance and pass through the eroded areas. The excavation of the trenches also damages the natural clay cover that protects the foreshore area. This could create a seepage flow that passes below the dyke causing internal erosion.

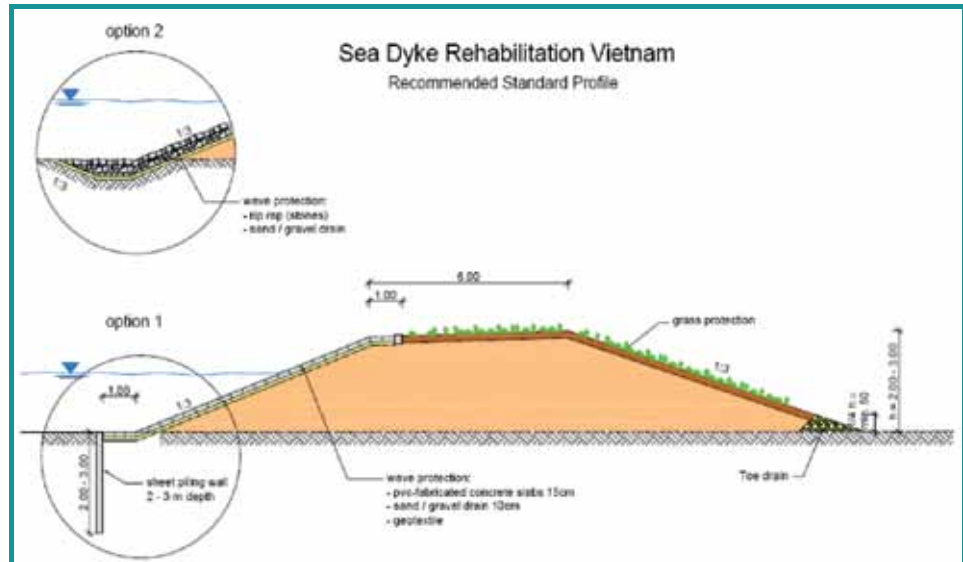
In order to demonstrate improved Sea Dyke construction and protection methods, the project has established the “Hon Dat Model Site” two km south of the mouth of the Hon Dat canal.

### **Recommended dyke construction methods**

- Dykes should be constructed in accordance with national guidelines.
- Use dyke construction material from the landward side and not from the seaward side.
- The dyke must be constructed of homogeneous soil material.
- The foundation area of the dyke should be cleared and compacted before construction.
- Material should be placed in layers of 30 - 40 cm and compacted to approx. 20 cm.
- It is strongly recommended that a dyke maintenance program is developed.



A proposed construction method is shown in the figure below.



Using soil in front of dyke  
exasperates erosion

The province now uses soil from  
behind the dyke for repairs.



## NEW LIVELIHOODS AS ADAPTATION TO CLIMATE CHANGE

A major challenge faced by development in Kien Giang Province which depends mainly on primary production for income generation is to manage the natural resource base for this production in a sustainable manner.

The project is introducing new livelihood methods and techniques through demonstrations, training and provision of seed funding. Successful models are then further demonstrated to a wider range of people. In this way local people will be better able to adapt to climate change and will incorporate the sustainable use of natural resources into their land management.

The livelihood activities specifically provide opportunities for poor women and ethnic people to get involved and benefit from the new technologies. Only projects that have strong commitment and contribution from local authorities and communities, and that have relevance to the adaptation to climate change and environmental sustainability are funded. Pilot activities are monitored for suitability for women, contribution to adaptation to CC and biodiversity as well as economic gain. This information is shared with the local authorities, the PPC, and DARD.

### Example activities follow:

#### **1. Vegetable and rice production model for poor and ethnic women in Vinh Thuan**

Small grant funding was provided through the Women's Union of Tan Thuan commune, to create new livelihoods using integrated farming methods. Previously, people in this area have only been able to plant one to two crops of rice each year, depending on irrigation water availability. They allow the land to remain fallow for the remaining time (3 - 4 months). This program supports local women to use infertile soils more efficiently through sustainable practice that improves crop productivity and income. It also increases environmental awareness through technical training on integrated farming management and integrated pest management (IPM).

Participants (39 poor women, including 5 Khmer) were selected at village meetings. Each woman received sufficient seed and materials to grow fruit/two vegetable (watermelon, bitter melon, tomato, Chinese bean) crops and a rice crop. This system resulted in an **increase of approximately 80% of their overall average annual income.**

#### **2. Sac Ran fish farming in the buffer zone of U Minh Thuong National Park**

This project aimed to improve the livelihood of local households in the buffer zone of U Minh Thuong National Park in U Minh Thuong district. An endemic species of fish 'Sac ran' are farmed under melaleuca forest. This activity creates an additional income from melaleuca forest management.

25 households in Cong Su village, An Minh Bac commune, with a water area of 44 ha were given technical training and received fingerlings and other material for fish farming. The income of participating households **increased by 150% of the annual income.**

#### **3. Blood shell culture along the mangrove protection forests in An Minh district**

This program aimed to help support local households in the Thuan Hoa commune to

effectively maintain and manage areas of mangrove protection forest along the coast line while generating an income through blood shell culture.

34 households with a total area of 25 ha of water surface were provided with material and technical training on blood shell production and mangrove forest management. The income of participating households **increased by 50% of the annual income**.

**Melaleuca plantation spacing, fertilizing and thinning in An Minh district**

This project examines ways to improve the financial return from melaleuca plantations. Through investigations of optimal plantation spacing, fertilizing and thinning, the project aims to promote the production of large size, high quality saw wood for furniture production (see relevant factsheets for more information).

Currently, 9 households have applied the thinning methods to 16 ha of melaleuca plantations.

The project has provided trainings and study tours for technical officers and farmers to look at a range of new options that could potentially suit their environments. For example, coconut production, GAP farming practice for vegetable, shrimp and pomelo, shell production. There has been strong uptake of coconut planting and shell production following these trips.

Poor woman fishing



Blood shells



Growing new variety of high value coconut



## ENVIRONMENTAL AWARENESS PROGRAM

Raising environmental awareness among the project target groups, including the population that uses the natural resources of the Kien Giang Biosphere Reserve, as well as the staff of the National Parks and the Provincial and District Departments is an important focus of the project. An environmentally aware population will make better-informed decisions and choices on complex environmental issues. Increased environmental awareness means that local people will be better able to adapt to climate change and to incorporate the sustainable use of natural resources into their land management.

An initial survey showed there was little community awareness of climate change (<3%) and related issues and identified the need to raise community awareness of

- What is a biosphere reserve,
- what is climate change and its impacts and
- the need to dispose of rubbish effectively.

The project subsequently developed a comprehensive public awareness campaign, targeted at a wide range of audiences, and based on building partner relationships and using multiple means of delivery such as mass media, a focus on special dedicated events, education and a range of information materials.

### **Building Relationships**

The project has helped create awareness of the challenges posed by climate change and the value of biodiversity through building relationships with community leaders, provincial stakeholders including government officials and local stakeholders (e.g. Women's Union, youth union). These relationships play a pivotal role in disseminating and reinforcing the messages of the project to a much wider audience.

### **Training Days**

Environmental awareness within our partner organisations and target groups has been strengthened through numerous workshops, training programs and study tours (domestic and international). For example, attendance by provincial officials at several conferences and workshops has improved awareness and informed implementation approaches on forest management. Training has been facilitated through the establishment of a dedicated training centre, a demonstration farm and a mangrove restoration demonstration site.

### **Community Environmental Events**

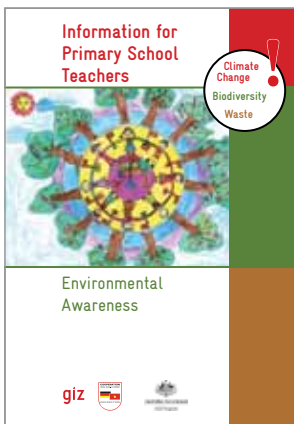
The project has used special events to encourage community participation in awareness generation and environmentally friendly behavior with great success.

- Over 2,000 people attended a tree-planting day in U Minh Thuong National Park.
- More than 2,000 people from 10 different organisations participated in a day for cleaning the environment.
- Around 1,000 people attended a training programme on how to plant coastal mangrove swamps in Hon Dat district.

### **Drawing attention to the issues**

Working together with the Provincial People's Committee and the Department of education the project conducts annual drawing competitions for Kien Giang students

to raise awareness of the importance of the environment. Selected drawings are made into a calendar.



**Environmental awareness in schools**

Environmental education and awareness-raising targeting schoolchildren are also key components in the campaign. Training of Trainer (ToT) workshops linked to key environmental issues of climate change and its impact, waste disposal and conservation of biodiversity in the biosphere were held for Primary and Secondary school teachers. More than 30 teachers and education officers from all districts within the biosphere reserve attended the workshops and identified a need for relevant resource material.

A resource book for primary school teachers on the topics of climate change, biodiversity and waste management has now been approved for implementation into the curriculum by the Department of Education and Training (DoET) and will be printed and distributed for use in schools mid 2011.

**Information materials and methods**

The project uses multiple means of delivery to provide information on environmental issues and project activities. Factsheets and case studies describe our success stories and lessons learned on adaptations to cope with climate change problems. The results of project activities are widely disseminated both within Viet Nam and internationally through presentations at seminars and conferences. The project also collaborates closely with the local TV and radio station to ensure coverage of all major project events. Environmental information can now be accessed online at: [www.kiengiangbiospherereserve.com](http://www.kiengiangbiospherereserve.com).

**Increased community awareness of environmental issues**

A recent survey found that 77% of respondents had heard of climate change and thought they would be affected by its impacts. Results of the survey showed that although issues of climate change, biodiversity management, coastal protection and waste management have reached a wide audience, men are more likely to be aware of the issues than women. TV and radio programmes and signs were shown to be very important tools to increase awareness.

Taking part in the clean-green day.





## CONCLUSION

The project supports the implementation of national Agenda 21, which gives the conservation of the sea, coastal areas and biodiversity, and mitigation of the consequences of climate change and natural disasters, as priorities for sustainable development. It is in line with Viet Nam's Comprehensive Poverty Reduction and Growth Strategy of 2002, and the National Environment Protection Strategy 2001-2010, passed in 2003, which anchor the conservation and use of natural resources as essential elements within the Vietnamese environment and development policy. Viet Nam has developed national action plans for the protection of biodiversity, wetlands and the environment for the period 2001 – 2010. The project is also in line with the National Socio-economic Development Plan 2006-2010 (SEDP).

At provincial level, the Biosphere Reserve is an important instrument to use in protecting its natural resources in the context of the rapid socioeconomic development. This project provided the first attempt to provide technical assistance and capacity building to enable provincial agencies to make the Biosphere Reserve operational.

The Project support for capacity building of the Kien Giang Biosphere Reserve Management Board will be an important process in participatory involvement of stakeholders as well as building an their awareness of the broader issues of environment management and sustainable socio-economic development.

The Project from 2011 will be part of a German – Australian Development Cooperation on Climate Change in the Mekong involving the Provinces of Kien Giang, Soc Trang, Ca Mau, An Giang and Bac Lieu. There will be synergies gained for the KGBR project from this collaboration particularly in benefits accruing from collaborative research projects to be conducted independently but in support of the development projects, dealing with the effects of climate change and involving Viet Nam and International Institutes. There are already opportunities for leveraging funding from other donors arising from the KGBR project such as the KfW preproposal assessment for a pilot dyke and mangrove restoration investment project in Kien Giang which would serve as a model for further such projects in other provinces.

The key to the Project's success is the excellent working relationship with the PPC, the Provincial Departments, Districts, Communes and the community bodies such as the Women's and Youth Unions.





